P.1

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Continued on the last page

(54) [Title of the Invention] TOUCH OPERATION INPUT DEVICE AND ELECTRONIC PARTS THEREOF

(57) [Claims]

[Claim 1]

A touch operation input device comprised of a touch position detection means with touch position detection sensors continuously arranged on a ring-shaped trajectory and a push switching means that turns the point of contact on and off, wherein the aforementioned push switching means arranged along the aforementioned trajectory on which the touch position detection sensors for the aforementioned touch position detection means are continuously arranged and the aforementioned push switching means turns the point of contact on and off by pressing operation on the aforementioned trajectory on which the touch position detection sensors for the aforementioned touch position detection means are continuously arranged.

[Claim 2]

A touch operation input device that has a structure of the touch operation input device according to Claim 1, wherein four of the aforementioned push switch are installed therein.

[Claim 3]

A small, portable device that employs the touch operation input device according to Claim 1 or Claim 2.

P.2

[Detailed Description of the Invention]

[Technical Field]

[0001]

This invention related to an touch operation input device that primarily detects contact of a finger and processes displacement information provided by fingertip movement, and a touch operation electronic part that is operated by a touch operation switch, contact detection, and push operation, and is mainly used in a remote controller for various electronic devices or small, portable electronic devices.

[Background Art]

[0002]

Conventionally, there has been a slide switch with a moveable knob that switches points of contact arranged one-dimensionally. Moreover, there is a rotation-type slide switch that switches points of contact arranged at regular intervals on a two-dimensional circle. These are equipped with a moveable knob that is not in itself a detection part of contact or displacement of the hand or finger. Furthermore, there is a contact sensor that turns the point of contact on and off by detecting contact. However, there has been no such a part that has contact sensors arranged continuously on a predetermined trajectory covered with a seamless part or integrated sheet for the finger to slide on the points of contact. Also, there has not been a device that operates based on an algorithm or logic that takes particular consideration of fingertip operation. Aside from the above cases, there is a touch panel, without a moveable knob, that was invented for detecting the position, displacement, and pressure of a fingertip or pen that moves on a two-dimensional plane or X-Y field. Nevertheless, there exist no electronic parts that detect the position, displacement, and pressure of a fingertip on a pre-arranged one-, two-, or three-dimensional trajectory and, at the same time, calculate the quantity of such displacement and movement, or such integrated electronic parts that have a function to output the information needed for calculating the quantity of displacement and movement. In addition, for devices using such electronic parts, an electronic part comprising a touch panel for contact operation and a switch for push operation are separately installed, and operation is conducted in a phased manner by both components. The following describes the typical structures and types of a touch panel mechanism.

[0003]

(1) Electrostatic induction type: a two-dimensional-plane touch position detection method that detects and interprets the capacitance change from the contact to non-contact status of a panel surface, in frequency, in phase, and so on. Some examples of this type are described

in "PCT International Publication No. WO92/08947 Official Gazette," "PCT International Publication No. WO92/14604 Official Gazette," "IEEE COMPUTER SOCIETY PRESS REPORT, 'A CAPACITANCE-BASED PROXIMITY SENSOR FOR WHOLEARM OBSTACLE AVOIDANCE' (by J. L. Noval and J. T. Feddema), Reprinted form PROCEEDINGS OF THE 1992 IEEE INTERNATIONAL CONFERENCE ON ROBOTICS AND AUTOMATION, Nice, France, May 12-14, 1994," and "Official Gazette for Kokai1996-77894," etc.

[0004]

(2) Resistance film type: a two-dimensional-plane touch position detection method that generates electric potential distribution on two conductive sheets provided separately for the X axis and Y axis, detects the voltage that changes when the panel surface provided with the aforementioned conductive sheets is contacted, and this method is employed in both an analog process and a digital process. Descriptions of this method are found in "Official Gazette for Kokai1972-36923," "Official Gazette for Kokai1986-208533," "Official Gazette for Kokai1996-54976," "Official Gazette for Kokai1992-4420," and "Official Gazette for Kokai1992-15813," etc.

[0005]

(3) Moveable electrode type: a two-dimensional-plane touch position detection method that has several electrodes for position detection on the X axis arranged at regular intervals, parallel to the Y axis, and another set of several electrodes arranged vertically to the Y axis, with either one set of electrodes designed to be moveable, thereby detecting pressure from the Z axis direction by means of contact between the arranged electrodes. Descriptions of this method are found in "Official Gazette for Kokai1992-15723," etc.

P.3

[0006]

(4) Optical detection type: a two-dimensional-plane touch position detection method that has infrared LEDs and phototransistors for position detection on the X axis provided on both ends of line segments arranged at regular intervals, parallel to the Y axis, intersecting the X axis, as well as another set of infrared LEDs and phototransistors for position detection on the Y axis provided on both ends of line segments arranged at regular intervals, vertical to the aforementioned line segments arranged for position detection, and thus detects the position and range that block the optical beam when pressure is applied from the Z axis direction. Descriptions of this method are found in "Official Gazette for Kokai1990-53129," "Official Gazette for Kokai1993-35403," etc.

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0007]

There has not been an invention for detecting the position, displacement, and pressure of a contacting object such as a fingertip or pen that moves or displaces along a predetermined trajectory of a line segment, curve, arc, or spherical surface intersecting a surface of a rugby-ball-shaped sphere, or a predetermined trajectory on line segments intersecting one another in a manner similar to the fingers of a bird foot. However, in case the touch detection sensor used in whatever touch panels, touch pads, tablets, or touch sensors described in all relevant official gazettes disclosed up until now is arranged continuously on a predetermined one-, two-, or three-dimensional curving trajectory in a strip, it is possible to detect the distance from the end of such a curving trajectory by straightening it in a straight line. Put simply, it is possible to detect the distance and duration of finger movement. Moreover, its applicable usage differs from that of a touch panel or slide switch, and the structure is also different from existing applications as it involves arrangement on a trajectory. In other words, the conventional two-dimensional touch detection structure is designed in one dimension, arranging the touch detection structure continuously on a trajectory. Therefore, it is possible to utilize part of the structural feature or advantage based on the basic principles applied in all kinds of touch panels, touch pads, tablets, or touch sensors that have been developed up until now.

[0008]

The actual situation today is that despite a large number of inventions for touch detection means or sensor types for position detection on an X-Y plane, there have been no inventions for touch detection on a specific trajectory due to the full attention being directed to the position detection on a two-axis plane. The structures employed in these inventions offer

suggestions very useful for touch detection on a predetermined trajectory of a line, plane curve, or space curve arranged in a string. Conventionally, the technical preference that a slide switch with a moveable part suffices as a detection method using points of contact arranged in a string has been widely shared, and the use of a slide switch has proved to be economical. However, it is difficult to miniaturize a slide switch to be used for mobile electronic devices, and its maintainability is not favorable due to its moveable mechanism. A rotation operation electronic means with a push switch such as the one published in the official gazette for Kokai1996-203387 has been currently used in a highly multi-function mobile electronic device having a number of input items for selecting an input item and entering it, but such a means has a moveable mechanism and requires certain depth. There has been a market request for realizing an analogue means of input without a moveable mechanism except for a push switch.

[0009]

There is an input device as described in the official gazette for Kokai1991-192418 that has a connecting mechanism that connects a position setting means to determine the position of an indicator for a predetermined coordinate system, a pressure-sensitive switch installed under the position setting means, and a switch that transmits pressure to the connecting mechanism that operates the pressure-sensitive switch when sufficient pressure is applied to the position setting means, wherein at least two plates are hinged together and extended under the connecting mechanism so that uniform pressure is virtually applied to all positions on the position setting means that operates the switch by the connecting mechanism. However, this device having a position setting means to determine the position of an indicator for a predetermined coordinate system is designed for position setting on a two-dimensional X-Y plane or a large coordinate system supported by at least two plates hinged and extended as indicated in the official gazette, yet this invention is not designed for a position setting means to detect the distance from a point on a predetermined trajectory on a string-shaped line, plane curve, or space curve, and also it forces the pressing pressure to be gathered at one point by means of a plate having a plane with such as a hinge. What is required is a kind of device that inputs displacement on a predetermined space curve defined as a controlled trajectory, or simply the contact status of a continuously arranged switch.

P.4

[0010]

Furthermore, most existing finger-touch position setting means are of such a large size as to require not only finger movement but also the snap of the wrist for input operation, and therefore few devices are equipped with a rotation operation electronic part with a push switch so that they can be operated using only one finger when the device is held in the hand. In addition, since sufficient strength can be given to the component parts of such a small input device, the position detection part and switch pressing part can be simply put together. Due to the growing requests for reducing the size and thickness of a remote controller or mobile electronic device that will enhance usability, it is increasingly required to reduce the size of switches, use less moveable parts, and build a device with fewer component parts as possible. However, the conventional structure comprised of such electronic parts as a touch panel for touch operation and a switch for push operation separately arranged is disadvantageous for miniaturizing the device, and the operability is considerably poor as the two parts must be operated separately.

[0011]

Against this background, this invention is designed to solve the conventional problems mentioned above and offer a touch operation input device capable of detecting the position, displacement, and pressure of the point of contact that moves and displaces along a predetermined one-, two-, or three-dimensional trajectory. Moreover, in an effort to solve the aforementioned current problems, it provides a touch operation input device with a push switch capable on its own of conducting multiple operations so that a conveniently operable, thin-design electronic device can be composed of a smaller number of parts.

[Means of Solving the Problems]

[0012]

For the reasons given above, this invention solves the aforementioned problems by a touch operation input device comprised of a touch position detection means equipped with touch position detection sensors continuously arranged on a predetermined line, plane curve, or space curve, and a switching means that turns the point of contact on and off in response to physical movement or pressing operation of a finger in a different direction from that in which the finger moves on the trajectory provided with the aforementioned touch position detection sensors to detect and integrate the information regarding the touch position on the trajectory provided from the aforementioned touch position detection means and the contact condition of the aforementioned switching means.

Similarly, this invention solves the aforementioned problems by a touch operation input device comprised of a touch position detection means equipped with touch position detection

sensors continuously arranged on a predetermined line, plane curve, or space curve, and a switching means that turns the point of contact on and off in response to physical movement or pressing operation in a direction perpendicular to a tangent line of the trajectory with the aforementioned touch position detection sensors arranged to detect and integrate the information regarding the touch position on the trajectory provided from the aforementioned touch position detection means and the contact condition turned on and off by the aforementioned switching means.

The aforementioned problems are solved also by employing an electrostatic induction detection means for the aforementioned touch position detection sensors used for the touch position detection means to detect the capacitance change as signal change from the contact to non-contact status of the points of contact provided on the trajectory.

The aforementioned problems are solved also by employing a moveable electrode detection means for the aforementioned touch position detection sensors used for the touch position detection means, wherein the first set of electrodes are arranged continuously on the trajectory and the second set of electrodes are arranged at regular intervals, while either one of these sets of electrodes is designed to be moveable and the other set is fixed so that this means for detection can detect the pressing operation of the finger.

The aforementioned problems are solved also by employing an optical detection means for the aforementioned touch position detection sensors used for the touch position detection means, wherein sets of a light emitting element and a light receiving element are continuously arranged on both sides of or underneath the trajectory.

The aforementioned problems are solved also by employing a resistance film detection means for the aforementioned touch position detection sensors used for the touch position detection means, wherein electrodes are provided on both sides of the trajectory and electrical potential distribution is generated by applying driving voltage and grounding voltage on the aforementioned electrodes so that displacement, movement quantity, or pressure can be detected by detecting the voltage at the position of contact.

P.5

The aforementioned problems are solved also by employing a direct current resistance detection method for the aforementioned touch position detection sensors used for the touch position detection means to detect the resistance of a finger or other objects contacting over metal contact points and convert the output level into the two values of high level and low level.

The aforementioned problems are solved also by employing an electromagnetic induction method using magnetic films for the aforementioned touch position detection sensors used for the touch position detection means.

The aforementioned problems are solved also by employing an ultrasonic method using a source of ultrasonic waves for the aforementioned touch position detection sensors used for the touch position detection means.

The aforementioned problems are solved also by designing the aforementioned switch to turn the point of contact on and off when the projections provided along one side or both sides of the aforementioned touch position detection area used for the touch position detection means are pressed down.

The aforementioned problems are solved also by providing a light emitting element that flickers depending on the status of the contact detection point at the aforementioned touch position detection area of the touch position detection means, or its periphery, or underneath the aforementioned touch position detection area in case it is designed to be optically penetrable.

The aforementioned problems are solved also by designing the aforementioned switch to merely turn the point of contact on and off without contacting the aforementioned touch position detection means and to adjoin the touch position detection means at all times so that the touch position detection means is able to operate simultaneously in conjunction with the pressing operation of the aforementioned switch.

The aforementioned problems are solved also by designing the aforementioned switch to merely turn the point of contact on and off without contacting the aforementioned touch position detection means and to be pressed at the same time together with the aforementioned touch position detection means when the point of contact is pressed down.

The aforementioned problems are solved also by designing the aforementioned switch to turn the point of contact on and off when an oscillating cam mechanism in which one of its sides is supported to oscillate is pressed down at its other end.

The aforementioned problems are solved also by designing the aforementioned touch position detection sensors to be arranged along a number of touch detection trajectories having equal units of displacement or differing units of displacement.

The aforementioned problems are solved also by arranging the aforementioned touch position detection sensors to be distributed uniformly in a wide band or distributed non-uniformly with varying density.

The aforementioned problems are solved also by arranging the aforementioned touch position detection sensors adjacent to the two or more to which detect at least one touch detection point.

The aforementioned problems are solved also by arranging the aforementioned switch to be provided with a number of push switches.

The aforementioned problems are solved by providing a touch position input area that generates an electric signal or voltage in response to the touch of a finger on a touch position detection area arranged continuously along a line or curve, a substrate with a point of contact that enables the aforementioned touch position input area to move horizontally within a predetermined range and has a means to transmit the electric signal or voltage between the aforementioned position input device and the point of contact, a spring structure that pushes the aforementioned touch position input area in a specific horizontal direction under a normal condition, and a push switch provided on the aforementioned substrate with a point of contact that is operated by pushing the aforementioned touch position input area against the spring push by the aforementioned spring structure.

The aforementioned problems are solved also by providing a touch position input area that generates an electric signal or voltage in response to the touch of a finger on a touch position detection area arranged continuously on a line or curve, a substrate that has on its upper surface a fixed point of contact for the aforementioned touch position detection area as well as a push switch to be operated from above, a member that is supported to oscillate by the supporting structure of the aforementioned substrate and has on its back surface a touch position input area with a point of contact corresponding to the fixed point of contact provided on the substrate, and an operating member having a sliced projection provided on a part of the periphery of the aforementioned member so as to operate the push switch with its tip in response to movement of the aforementioned member, wherein the push switch is pressed when sufficient pressure is applied to the member having the touch position input area.

P.6

The aforementioned problems are solved also by providing a touch position input area that generates an electric signal or voltage in response to the touch of a finger on a touch position detection area arranged continuously on a line or curve, a substrate that has on its upper surface a fixed point of contact for the aforementioned touch position input area as well as a push switch part to be operated from above, a supporting structure vertically attached on both sides or the central downside of the touch position input device is inserted into guiding holes provided in the substrate to be guided to go up and down, an elastic member installed between the aforementioned touch position input device and the substrate that bounces the touch position input area in the direction of the locking part at the upper section of the substrate at all times; wherein the push switch is pressed when sufficient pressure is applied onto the touch position detection device against the bouncing push by the aforementioned elastic member.

The aforementioned problems are solved also by providing a touch position input area that generates electric signal or voltage in response to the touch of a finger on a touch position detection area arranged continuously on a line or curve, wherein a member supporting the aforementioned touch position input area to be connected to a connecting member by means of dents, holes, or penetrating holes provided in each of the aforementioned touch position input areas is designed a push switch to be pushed by pushing the aforementioned touch position input area against the spring push by a spring structure that pushes the aforementioned touch position input device in a specific horizontal direction is designed.

The aforementioned problems are solved also with a means comprised of a touch position input area that generates an electric signal or voltage in response to the touch of a finger on a touch position detection area arranged continuously on a line or curve and an elastic member for a member that pushes or presses the aforementioned touch position input area in a specific direction, wherein a push switch is pushed by means of the compression or extension of the aforementioned elastic member that is triggered by the pushing of the aforementioned touch position input area against the elastic push mentioned above.

The aforementioned problems are solved also with a means comprised of a touch position input area that generates an electric signal or voltage in response to the touch of a finger on a touch position detection area arranged continuously on a line or curve wherein a push switch is pushed by means of the compression or extension of an elastic member separately from the aforementioned touch position input area.

The aforementioned problems are solved also by arranging a means in a single device to push the aforementioned push switch to be located at a distance from the position where a

touch position input area is located or to be located adjacent to the vicinity where a touch position input area is located.

The aforementioned problems are solved also by providing the fingertip contact surface of the aforementioned touch position detection means with surface unevenness.

The aforementioned problems are solved also by providing the keytop with a touch detection sensor to have a means to detect one contact event.

The aforementioned problems are solved also by providing the keytop with a number of touch detection sensors to have a means to detect more than one contact event.

The aforementioned problems are solved also by providing the keytop with a touch panel.

The aforementioned problems are solved also by providing the keytop with a touch panel to provide a means to detect touch.

The aforementioned problems are solved also by designing the aforementioned switching means so that the keytop is provided with a touch detection area and the point of contact for the sensor is moved apart when being pushed.

The aforementioned problems are solved also by designing the aforementioned switching means to be of the momentary type, alternate type, or lock type.

P.7

[0013]

The touch operation input device of this invention enables analogue information regarding displacement or movement of a finger, the most sensitive, touch-detecting, operation tool of the human body, moving on a trajectory to be input into an electronic device, also enabling detection of the position, displacement, and pressure of a point of contact moving or displacing along a predetermined one-, two-, or three-dimensional trajectory. By means of an operation part installed therein, a large number of functions can be selected, a switch input using, for example, a volume switch can be conducted with high accuracy, or, when used as a touch detection switch for inputting information by means of the number of sensor touch events, the number of input events can be freely adjusted by finger operation or the number of events can be altered by changing the location where the finger makes contact, and thereby operability and multi-functionality can be improved. Moreover, the structure of the operation mechanism as a component of such a highly operable electronic device can be simplified, improving maintainability at the same time. It also enables simultaneous operation of the functions of both a touch operation electronic part and a push switch by means of a single operation part. Furthermore, unlike the conventional rotation operation part with a push switch, the operation mechanism of this invention can be thinly structured in the pushing direction, and therefore, can be located at the center of the device, and the operation can be easily conducted by either hand in case the operation part is installed in a device that is designed to be handled by a single hand. Additionally, by means of the push key with the above touch detection sensor, event input is possible with contact or by considerably subtle pressing operation in addition to regular key pressing operation.

[Effect of the Invention]

[0014]

This invention is comprised of the components in the manner mentioned above; particularly, it enables analogue information regarding displacement or movement of a finger moving on a trajectory to be input into an electronic device, and also enables the detection of the position, displacement, and pressure of a point of contact moving or displacing along a predetermined one-, two-, or three-dimensional trajectory. It also offers a touch operation electronic part with a push switch that is capable of conducting multiple operations using a single part so that a highly operable, thin-design electronic device can be composed of a small number of component parts.

[0015]

By means of an operation part installed therein, a large number of functions can be selected, a switch input using, for example, a volume switch can be conducted with high

accuracy, or, when used as a touch detection switch for inputting information by means of the number of sensor touch events, the number of input events can be freely adjusted by finger operation or the number of events can be altered by changing the location where the finger makes contact, and thereby operability and multi-functionality can be improved. Moreover, the structure of the operation mechanism as a component of such a highly operable electronic device can be simplified, improving maintainability at the same time. It also enables a simultaneous operation of the functions of both a touch operation electronic part and a push switch by means of a single operation part. Furthermore, unlike the conventional rotation operation part with a push switch, the operation mechanism of this invention can be thinly structured in the pushing direction, and therefore, can be located at the center of the device, and the operation can be easily conducted by either hand in case the operation part is installed in a device that is designed to be handled by a single hand. Additionally, by means of the push key with the above touch detection sensor, event input is possible with contact or by considerably subtle pressing operation in addition to regular key pressing operation.

[Embodiments of the Invention]

[0016]

Now, embodiments of this invention will be described with reference to the drawings. For example, a touch operation input device comprised of a touch position detection means equipped with touch position detection sensors continuously arranged on a predetermined line, plane curve, or space curve, and a switching means of, for example, momentary type, alternate type, or lock type, that turns the point of contact on and off in response to the physical movement or pressing operation of a finger in a different direction from that in which the finger moves on the trajectory with the aforementioned touch position detection sensors arranged, having a mechanism structure that detects and integrates the information regarding the touch position on the trajectory provided from the aforementioned touch position detection means, the contact condition of the aforementioned switching means or the information regarding the distance from the point of contact on the trajectory provided from the aforementioned touch position detection means, and the contact condition turned on or off by the aforementioned switching means.

P.8

Also, below are some specific examples of a circuit structure of a touch position detection means. Namely, there are numerous types of touch panel applications that output signals or voltage for a position being touched according to the contact or pressure detected mainly on a X-Y plane, and the following gives detailed explanations of the specific structure employed.

[0017]

The structure using an electrostatic induction detection means (capacitance) as the touch position detection means involves a detection method that has multiple capacitors C1, C2, C3, ... through non-conductive glass for detecting contact via fingers where the capacity of these capacitors C1, C2, C3, ... changes according to the touch or proximity. Here, these capacitors C1, C2, C3, ... are connected continuously under the predetermined trajectory. As shown in Figure 1, the pulse generation circuit 1 transmits sequentially to these capacitors C1, C2, C3, ... connected continuously frequency signals generated by the CR phase oscillator circuit 3 by applying voltage through the scanning drive circuit 2 that houses a decoder and counter to the frequency comparison circuit 4. These signals are compared with standard signals transmitted to the frequency comparison circuit 4 via the control circuit 5 from the pulse generation circuit 1, and moreover, signals from the frequency comparison circuit 4 and standard signals from the control circuit 5 are simultaneously transmitted to the decision circuit 6. Based on the decision regarding both types of signals, the point of finger contact is detected by detecting the capacitor capacity.

[0018]

Next is a description of the structure using a moveable electrode type detection means (moveable electrode switch type) as the touch position detection means. As shown in Figure 2 (a), either a linear electrode arranged continuously along a trajectory or the electrode arranged intermittently with gaps filled with spacers 13 is designated as the moveable electrode 14 while the other is designated the stationary electrode 15. Using the finger, pressure is applied to the moveable electrode 14 to contact the stationary electrode 15 side. The buring and duration of the point of contact is used to detect the finger contact point. In Figure 2 (b), the control circuit 10 activates the counter 11 to sequentially detect the points of contact S1, S2, S3, ... from the decoder 12. At this point, the part of the contact point that is turned ON has LOW voltage to detect the point of contact.

[0019]

Next is a description of the structure using an optical detection means (infrared detection type) as the touch position detection means: This is a method that performs finger touch detection as shown in Figure 3. There are several luminous elements 20 such as LEDs and light receiving elements 21 such as phototransistors that are arranged 1:1 continuously on

both sides of the trajectory for touch detection of a finger and other objects. These luminous elements 20 light up sequentially according to the demultiplexer 22 and the light is synchronized by the multiplexer 23 is received by the light receiving elements 21 via the multiplexer 23. The luminescence level of the light received by these light receiving elements 21 is detected by the decision circuit 24. Based on the decision processed regarding the level of light, the finger touch position is detected. Note that 25 refers to the control circuit that controls each of their circuit functions and is connected to the above demultiplexer 22, the multiplexer 23, and the decision circuit 24. The dotted line box in Figure 3 is the AD converter 26 that can be provided between the multiplexer 23 and the decision circuit 24, which enables the detection of analogue values in connection with the point of contact and thus improves detection accuracy. Other examples of the optical detection means are, as shown in Figure 4, a type in which a set of light receiving elements 21 and luminous elements 20 are provided beneath the contact position, or, as shown in Figure 5, a type in which sets of light receiving elements 21 and luminous elements 20 are provided on both sides of the contact position. It is also possible to arrange the push switch 47 that is mentioned afterwards between the light receiving elements 21 and luminous elements 20.

P.9

[0020]

Next is a description of the structure using a resistance film type detection means (resistance film electrode type) as the touch position detection means of the touch detection. As shown in Figure 6, a uniform resistance film 30 is sandwiched between the electrode A and electrode B whereby the potential distribution Q is generated when driving voltage and grounding voltage are applied. As shown in Figure 7, the electrode 31 that is conductive to this resistance film 30 is installed in a parallel direction either under or on top of the resistance film 30. When touched with a finger, the resistance film 30 and the electrode 31 contact each other in a conduction state. This contact detects the position of the point of contact by measuring the changed voltage on the voltage measuring device 32. With any type of detection means as described above, the point of contact is output as position data on the one-dimensional coordinates to correspond 1:1 to its trajectory. In particular, using an analogue method or a method sufficiently comparable to an analogue method, it is possible to easily identify the direction of fingertip movement, and with a digital method, such identification is also possible provided there are many points of contact.

[0021]

Next is a description of the structure using a direct current resistance detection method as the touch position detection means. The example shown in Figure 11 involves the application of the BA653 touch sensor mounted with 7 circuits having input dynamic resistance of 2MΩ, where the detection circuit unit detects the high level of resistance such as finger contact extending across the metal contact point switches SW1 to SW7, and then the high resistance detection element switch module SM converts the output level ranging from OUT1 to OUT7 to two values of HIGH and LOW that are mainly used as the switches to detect contact with the metal.

[0022]

In addition to the above, an electromagnetic induction method that uses a magnetic film instead of the aforementioned resistance film is possible, or an ultrasonic detection method that uses an ultrasonic wave source in place of the aforementioned infrared LED can be employed.

[0023]

An embodiment of the aforementioned switching means is as follows. As shown in Figure 8, the contact point 42A is provided on the substrate 49 contained inside the casing P, with the fan-shaped, button-type push switch 47 installed covering over the contact point 42A provided on the substrate 49, connected with the elastic member 55 made of skirt-ring-shaped rubber material, while the contact point 42B is provided on the lower side

of the push switch 47, facing the contact point 42A on the substrate 49. On a side of the push switch 47 is arranged the touch position detection area 40 in an arc shape that is connected with the cable socket of the touch position input part 44 installed on the lower side of the substrate 49 via the cable K, so that when the push switch 47 is pressed down, the contact points 42A and 43B contact each other in a conduction state, thus turning the switch on. Specifically, this embodiment can be applied to the click button of a mouse used for computers or similar switch devices.

[0024]

In addition, the light emitting elements 43 that flickers depending on the status of the contact detection status can be sequentially provided in the aforementioned touch position detection area 40 of the touch position detection means, on its periphery, or underneath the aforementioned touch position detection area 40 in case it is designed to be optically penetrable (see Figure 9). This embodiment can be applied, for example, to the volume control of a music instrument such as an electronic piano without a confirmation switch.

[0025]

With regard to the aforementioned switching means, it can be so designed as shown in Figure 10 (a) and (b) that the fingertip only turns the contact point 42 on and off without touching the aforementioned touch position detection area 40, while it can adjoin the touch position detection area 40 at all times so that pressing operation of the contact point 42 is interlocked to also press down the touch position detection area 40, or it can be designed as shown in Figure 10 (c), (d) and (e) so that the fingertip only turns the contact point 42 on and off without touching the aforementioned touch position detection area 40, while it can adjoin the touch position detection area 40 at all times so that pressing operation of the contact point 42 also simultaneously presses down the touch position detection area 40.

P.10

[0026]

The aforementioned switching means can be so designed as shown in Figure 19 that it turns the point of contact on and off by means of the triangular cam part 70, one of whose apexes is supported inside the casing P in a moveable manner to comprise an oscillating cam mechanism in which the aforementioned cam part 70 can be horizontally moveable, and the other of the apexes is pressed when the touch position detection area 40 is pressed down.

[0027]

An embodiment of applying this invention to a touch operation electronic part with a push switch is, as shown in Figure 12, the touch position input part 44 that generates an electric signal or voltage according to the contact status of a finger on the touch position detection area 40 that is continuously arranged along a straight line or curved line, while the substrate 45 with a point of contact is installed to support the touch position input part 44 to remain moveable horizontally within a predetermined range, and to have a means of transmitting the electric signal or voltage between the contact point of the touch position input part 44, and the coil-shaped spring part 46 is provided to press the touch position input part 44 in a horizontal direction at all times. By employing the so-called horizontally sliding method that pushes the aforementioned touch position input part 44 against the spring push by the aforementioned spring part 46, the push switch 47 installed on the substrate 45 with a point of contact is operated.

[0028]

Or, as shown in Figure 13 (b) and (c), it can be so designed that a structure comprised of the touch position input device 44 that generates an electric signal or voltage in response to the touch of a finger on a touch position detection area 40 continuously arranged on a straight line or curved line, the substrate 49 that has on its upper surface the fixed point of contact 48 for the aforementioned touch position input device 44 as well as the push switch 47 to be operated from the top, the oscillating member 52, having a form of hinge, that is supported around its center by the supporting structure 50 to be allowed to oscillate via the spring part 46, and to be provided on the aforementioned substrate 49, and having on its lower face the touch position input device 44 with a point of contact corresponding to the fixed point of contact 48, and the operating member 53 having a sliced projection that is provided at part of the tip of the aforementioned oscillating member 52 so as to operate the push switch 47 in response to the pressing oscillation of the aforementioned oscillating member 52 in a pressing direction against the bouncing push by the spring part 46, whereby the operating member 53 presses the push switch 47 when sufficient pressure is applied to the specific member of the touch position input area 40. Or, two types of input operation are

possible using two push buttons when, as shown in Figure 13 (a), a set of the operating members 53 having a sliced projection on both sides of the oscillating member 52, is arranged similar to a seesaw, while providing a set of push switch 47A and 47B that corresponds to the aforementioned operating members 53.

[0029]

Or, as shown in Figure 14 (a), Figure 22 (a) and (b), it can be so designed that a structure comprised of the touch position input device 44 that generates an electric signal or voltage in response to the touch of a finger on a touch position detection area 40 continuously arranged on a straight line or curved line, the substrate 49 that has on its upper surface the fixed point of contact 48 for the aforementioned touch position input device 44 as well as the push switch 47 to be operated from above, the supporting structure 60 vertically attached on both sides or the central downside of the touch position detection area 40 that is inserted into the guiding holes 61 provided in the substrate 49 to be guided to go up and down, and such an elastic member as the coil-shaped spring part 46 installed between the aforementioned touch position input device 44 and the substrate 49 that bounces the touch position detection area 40 up in the direction of the locking part 49A at the upper section of the substrate 49 at all times, whereby a structure that presses the push switch 47 when sufficient pressure is applied to the touch position detection area 40 against the bouncing push by the aforementioned spring part 46. Moreover, Figure 14 (b) shows a structure where the touch position detection area 40 is shaped in the form of push button, while the supporting structure 60 attached on the downside of the touch position detection area 40 is inserted into the tube-shaped guiding holes 61 provided in the substrate 49 to be guided to go up and down, and the coil-shaped spring part 46 is installed between the touch position input device 44 and the substrate 49.

P.11

Furthermore, in case the push switch 47 is provided at three locations as shown in Figure 15 (c) and (d), such embodiment can be preferably used for character input operation of computers or word processors. In this case, the touch position input device 44 is sandwiched by the plate spring 62 provided on both sides, and therefore, in addition to pressing operation of the push switch 47A in the lower direction by applying pressure on the touch position detection area 40, by slanting the touch position detection area 40 in two horizontal directions against the push by the plate spring 62, either the push switch 47B or 47C can be pressed. Additionally, in case the push switch 47 is provided at two locations as shown in Figure15 (a) and (b), a structure can be designed so that the lower tip of the touch position input device 44 is supported in such a way that the touch position input device 44 can oscillate freely to the right or left, and thus either the push switch 47B or 47C installed on the right and left of the touch position input device 44 can be pressed.

[0030]

Another example of embodiment can be so designed that a structure comprised of the touch position input device 44 that generates an electric signal or voltage in response to the touch of a finger on the touch position detection area 40 arranged continuously on a straight line or curved line, employing as a method of supporting the aforementioned touch position input device 44 to be inserted to the guiding connecting member 54 by means of dents, holes, or penetrating holes provided in the aforementioned touch position input device 44, and by designing the push switch 47 to be pushed by pushing the aforementioned touch position input device 44 against the spring push by the spring structure 46 that pushes the aforementioned touch position input device 44 in a specific horizontal direction.

[0031]

Furthermore, as shown in Figure 16 (a) to (d), a structure comprised of the touch position input device 44 that generates an electric signal or voltage in response to the touch of a finger on the touch position detection area 40 so that a member as the one-way push mechanism 90 that pushes or presses the aforementioned touch position input device 44 in a specific direction can be employed to turn the point of contact 42 on and off. Or, such a structure can employ a means to push the push switch 47 against the compression or extension of a rubbery elastic member by pushing the aforementioned touch position input device 44 against the elastic force mentioned above. Or, as shown in Figure 14 (c), the switching means can employ the projection 41 provided along one or both sides of the touch position detection area 40 of the aforementioned touch position input means so that when the projection 41 is pressed, the contact point of the push switch 47 is turned on and off. Specifically, such a means can be applied to the click button of a mouse used for computers

or similar switch devices, or a keyboard for computers or word processors. In case the above touch operation electronic part with a push switch is used for a keyboard for computers or word processors, the entire keyboard can function as a sensor detecting contact, or in the case of application to the keytop of a mobile phone, the keytop functions as a sensor and thus the number of the keys can be reduced. Moreover, unlike the conventional rotation operation part with a push switch, the above mechanism can be thinly structured in the pushing direction, and therefore, can be located around the center of the device, and the operation can be easily conducted by either hand in case the operation part is installed in a device that is designed to be handled by a single hand. Additionally, the fingertip contact surface of the aforementioned touch position detection area 40 is provided with surface unevenness so as to make it easier to identify the input events.

[0032]

The aforementioned touch position detection sensors can be arranged along a number of touch detection trajectories having equal units of displacement or differing units of displacement, or distributed uniformly in a wide band or non-uniformly with varying densities. More specifically, the distribution of the touch position detection sensors can be designed to be denser on both sides of or around the middle of the trajectory, or toward one end or both ends of the trajectory, and thus the number of input events can be freely adjusted by the operation of a finger or the number of events can be altered by changing the location where the finger makes contact.

P.12

Additionally, the aforementioned touch position detection sensors can be two or more sensors adjacent to each other which detect at least one touch detection point.

[0033]

With regard to the means of pressing down the aforementioned push switch,, the push switch 47 installed on a mobile phone can be separately arranged to be on the other side of the location where the touch position detection area 40 is arranged as shown in Figure 18 (a), or the push switch 47 can be arranged to be in a location adjacent to the touch position detection area 40 as shown in Figure 18 (b) to (d), or Figure 17. Namely, in Figure 17 (a), the string-shaped push switch 47 is arranged in parallel to the string-shaped touch position detection area 40 adjacent to each other on one side of the mobile phone, while in Figure 17 (b), the round-shaped push switch 47 is arranged around the arc-shaped touch position detection area 40 adjacent to each other on one side of the mobile phone. Moreover, in Figure 18 (b), the round-shaped push switch 47 is arranged below the string-shaped touch position detection area 40 arranged in a longitudinal direction around the center of the mobile phone, in Figure 18 (c), both the string-shaped push switch 47 and the string-shaped touch position detection area 40 are arranged alongside each other in a longitudinal direction around the center of the mobile phone, while in Figure 18 (d), the round-shaped push switch 47 is arranged under the string-shaped touch position detection area 40 around the center of the mobile phone. In addition, in Figure 18 (e) and (f), the push switch 47 is arranged in the center of the round-shaped or rhombic-shaped touch position detection area 40, while in Figure 18 (g), the push switch 47 is arranged at the outer periphery of the round-shaped touch position detection area 40, and other variations can be possibly considered.

[0034]

In the case of having an input key simply turning the contact point on and off to conduct additional input operation by means of slight contact pressure, or having an input device simply turning the contact point on and off to conduct input operation of analogue information, as shown in Figures 20 and 21, a touch detection means for a single contact can be provided by providing, for example, the small, round-shaped touch detection sensor 81 on the keytop 80 (see Figure 21 (a)), or a touch detection means can be provided by providing the rhombic, panel-shaped touch detection sensors 81A, 81B, ... on the keytop 80 (see Figure 20 (b)), or a touch detection means can be provided by providing the rhombic touch panel 82 on the entire surface of the keytop 80 (see Figure 20 (c) and (d)). Moreover, along the upper surface of the periphery of the keytop 80, the ring-shaped touch detection part 83 can be provided for operation by a finger sliding along on it, and the contact point 84 can be arranged to be turned on when the keytop 80 is pressed down (see Figure 20 (a) and (b)) or to

be turned off conversely.

[Brief Description of the Drawings]

[0035]

[Figure 1] This is a circuit diagram of the electrostatic induction detection method for the embodiment of this invention.

[Figure 2] This is a diagram of the moveable electrode detection method for the embodiment of this invention; (a) is a circuit diagram and (b) is a cross-sectional view.

[Figure 3] This is a circuit diagram of the optical detection method for the embodiment of this invention.

[Figure 4] This is a diagram of the arrangement of the luminous element and light receiving element of the optical detection method for the embodiment of this invention, while (a) is a cross-sectional view and (b) is a plane view.

[Figure 5] This is another diagram of another arrangement the luminous element and light receiving element of the optical detection method for the embodiment of this invention.

[Figure 6] This is a conceptual diagram of the resistance film detection method for the embodiment of this invention, while (a) is a diagram showing the arrangement of the resistance film and (b) is a diagram explaining the voltage distribution.

[Figure 7] This is a circuit diagram of the resistance film detection method.

P.13

[Figure 8] This is a diagram showing the switching means for the embodiment of this invention, while (a) is a cross-sectional and (b) is a plane view.

[Figure 9] This is a diagram of the touch position detection device for the embodiment of this invention.

[Figure 10] This is a conceptual diagram of other switching means for the embodiment of this invention, explaining the situation when only the switch is pressed down and the situation when the center of the touch position detection device is pressed down.

[Figure 11] This is a circuit diagram of the direct current resistance detection method for the embodiment of this invention.

[Figure 12] This is a diagram of the touch operation electronic part with a horizontally sliding push switch for the embodiment of this invention.

[Figure 13] This is another diagram of other application examples of the touch operation electronic part with a push switch, where (a) is a seesaw type, (b) is a hinge type, and (c) is a front view of (b).

[Figure 14] This is still another diagram of other application examples of the touch operation electronic part with a push switch, where (a) is a flat type electronic part, and (b) and (c) show button type electronic parts.

[Figure 15] This is still another diagram of other application examples of the touch operation electronic part with a push switch.

[Figure 16] This is still another diagram showing a perspective view of other application examples of the touch operation electronic part with a push switch.

[Figure 17] This is still another diagram showing a perspective view of other application examples of the touch operation electronic part with a push switch, where (a) is a string-shaped type and (b) is a round-shaped type.

[Figure 18] This is still another schematic diagram of other application examples of the touch operation electronic part with a push switch.

[Figure 19] This is still another schematic diagram of other application examples of the touch operation electronic part with a push switch.

[Figure 20] This is still another schematic diagram of other application examples of the touch operation electronic part with a push switch.

[Figure 21] This is still another schematic diagram of other application examples of the touch operation electronic part with a push switch.

[Figure 22] This is still another schematic diagram of other application examples of the touch operation electronic part with a push switch.

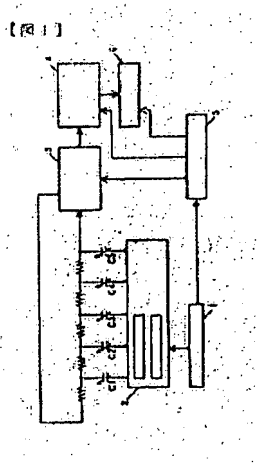
[Explanation of Reference Numerals]

[0036]

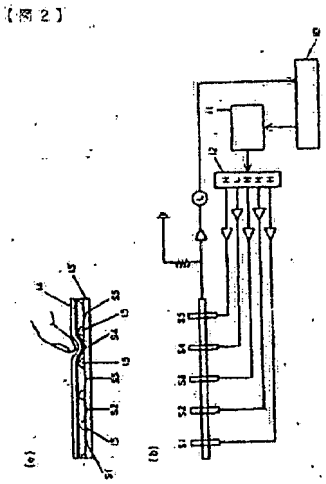
1. Pulse generation circuit
2. Scan drive circuit
3. CR phase oscillator
4. Frequency comparison circuit
5, 10, 25. Control circuit
6, 24. Decision circuit
11. Counter
12. Decoder
20. Luminous element
21. Light receiving element
22. Demultiplexer
23. Multiplexer
26. AD converter
30. Resistance film
31. Electrode
40. Touch position detection area
41. Projection
42, 51. Contact point
43. Light emitting element
44. Touch position input device
45. Substrate with a contact point
46. Spring part
47. Push switch
49. Substrate
52. Oscillating part
53. Operation part
55. Elastic member

P.14

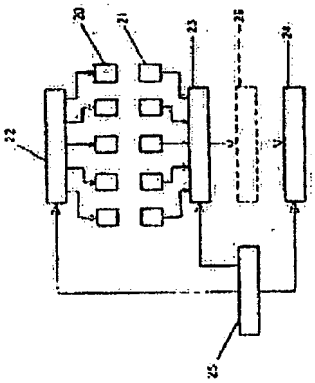
[Figure 1]



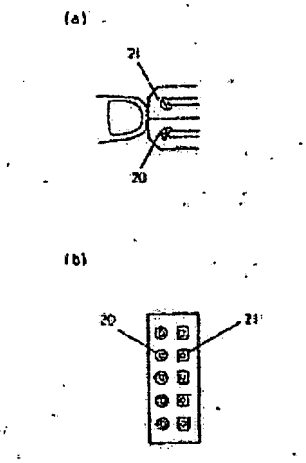
[Figure 2]



[Figure 3]

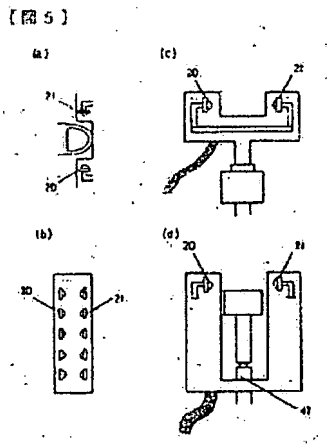


[Figure 4]

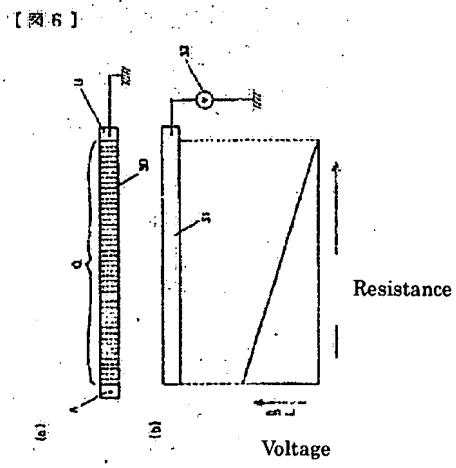


P.15

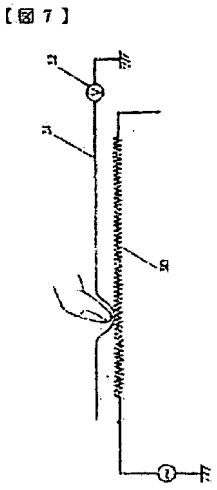
[Figure 5]



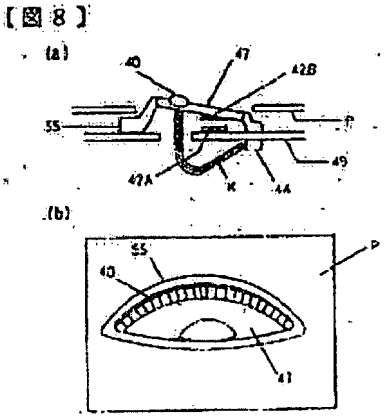
[Figure 6]



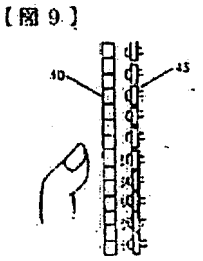
[Figure 7]



[Figure 8]

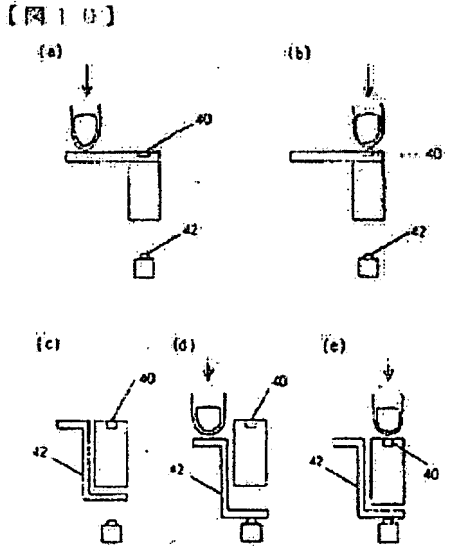


[Figure 9]

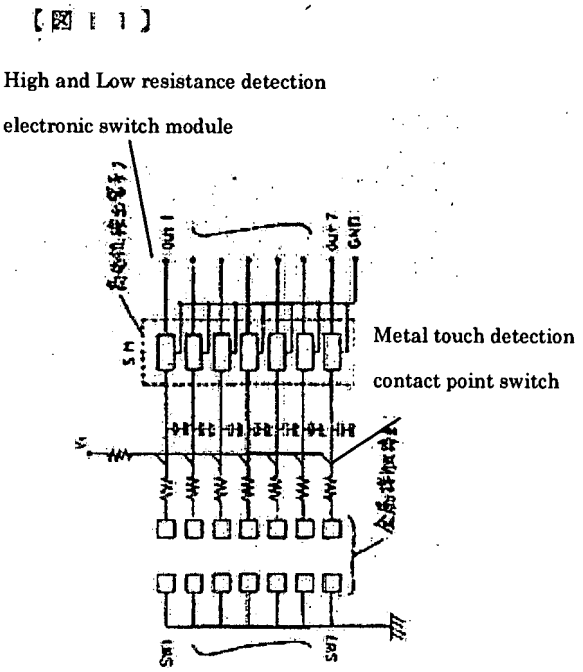


P.16

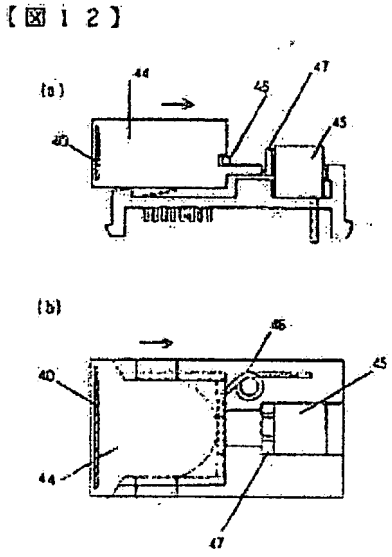
[Figure 10]



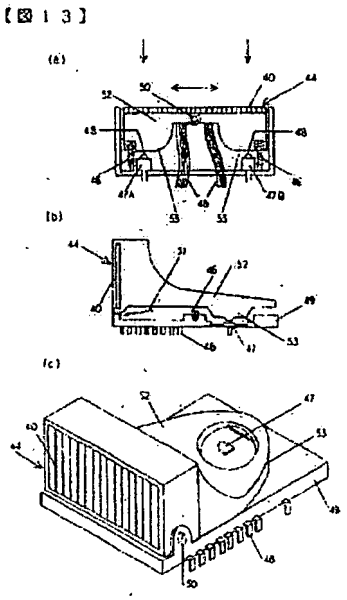
[Figure 11]



[Figure 12]



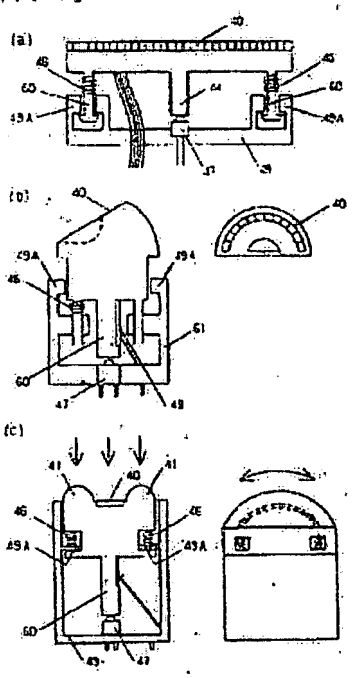
[Figure 13]



P.17

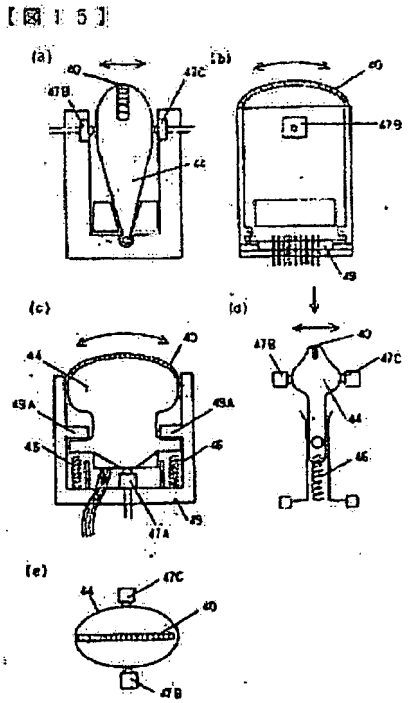
[Figure 14]

【図１４】



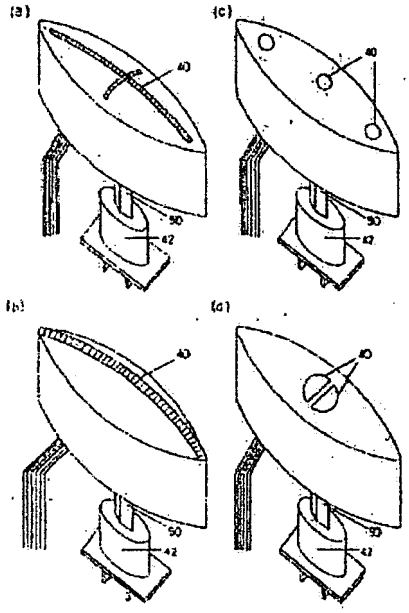
[Figure 15]

【図１５】



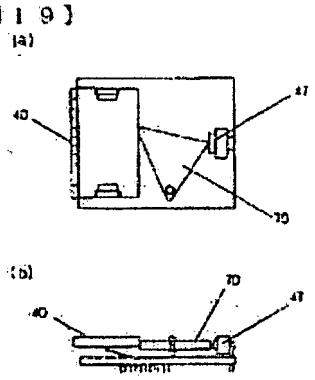
[Figure 16]

【図１６】



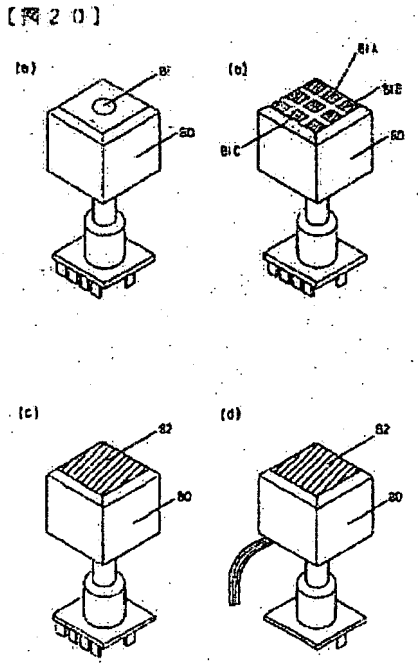
[Figure 19]

【図１９】

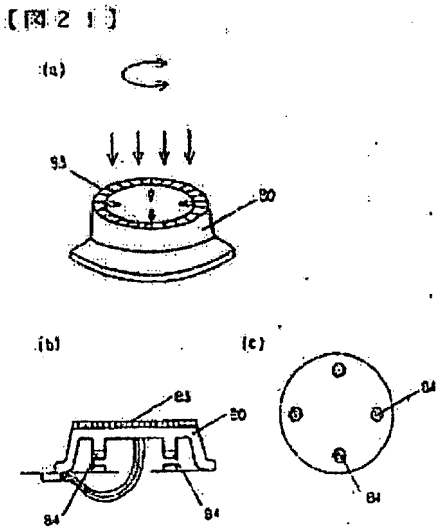


P.18

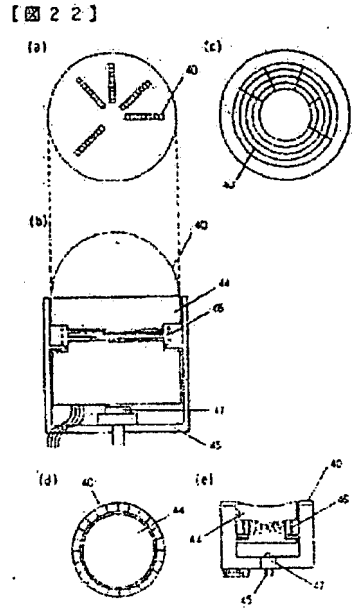
[Figure 20]



[Figure 21]



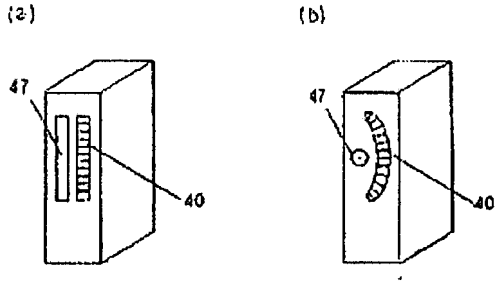
[Figure 22]



P.19

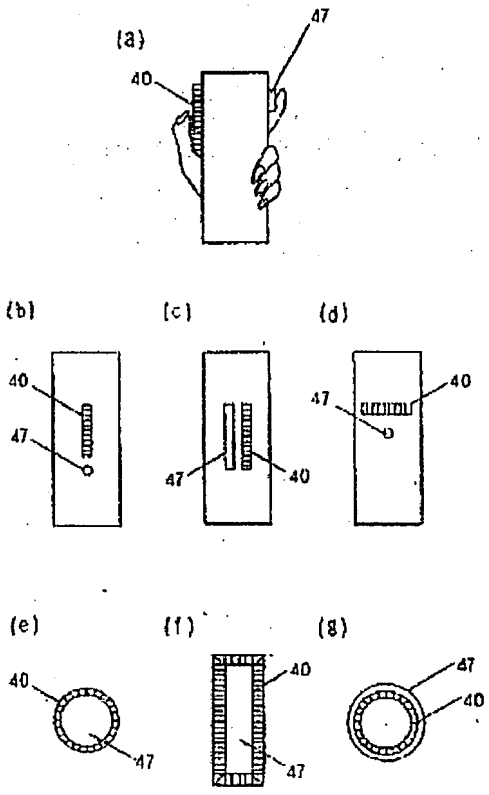
[Figure 17]

【図１７】



[Figure 18]

【図１８】



P.21

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(58) Examined Fields (Int. Cl., DB name)

G06F 3/02 – 3/027
G06F 3/03 – 3/047
H01H 13 00 – 13/76
H04M 1/02 – 1/23
H04M 1 247